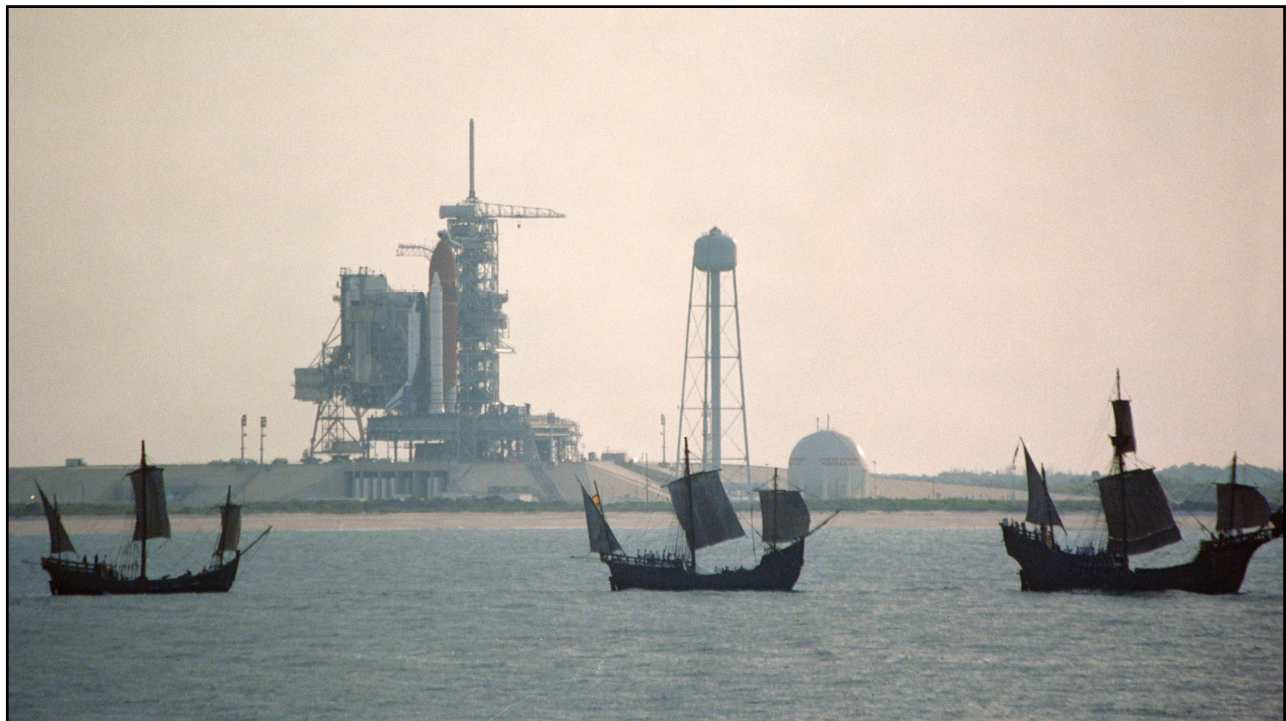


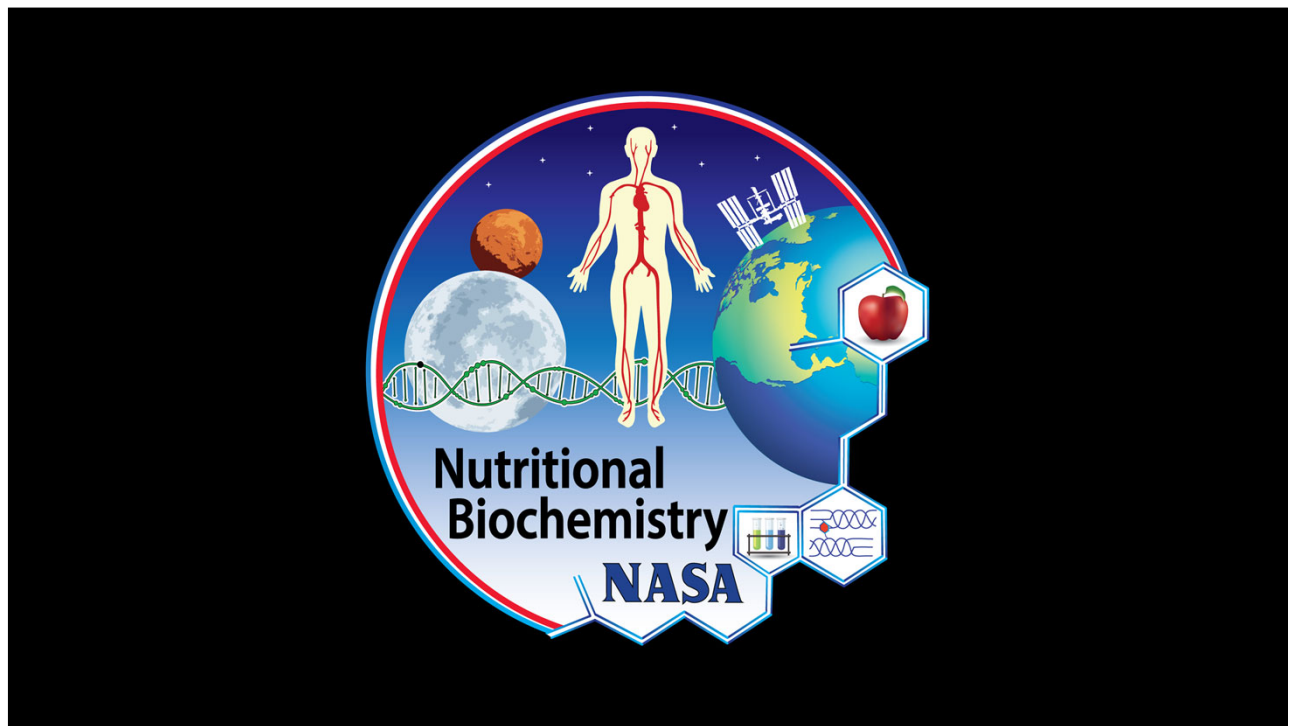
Nutrition as Fuel for Human Space Exploration



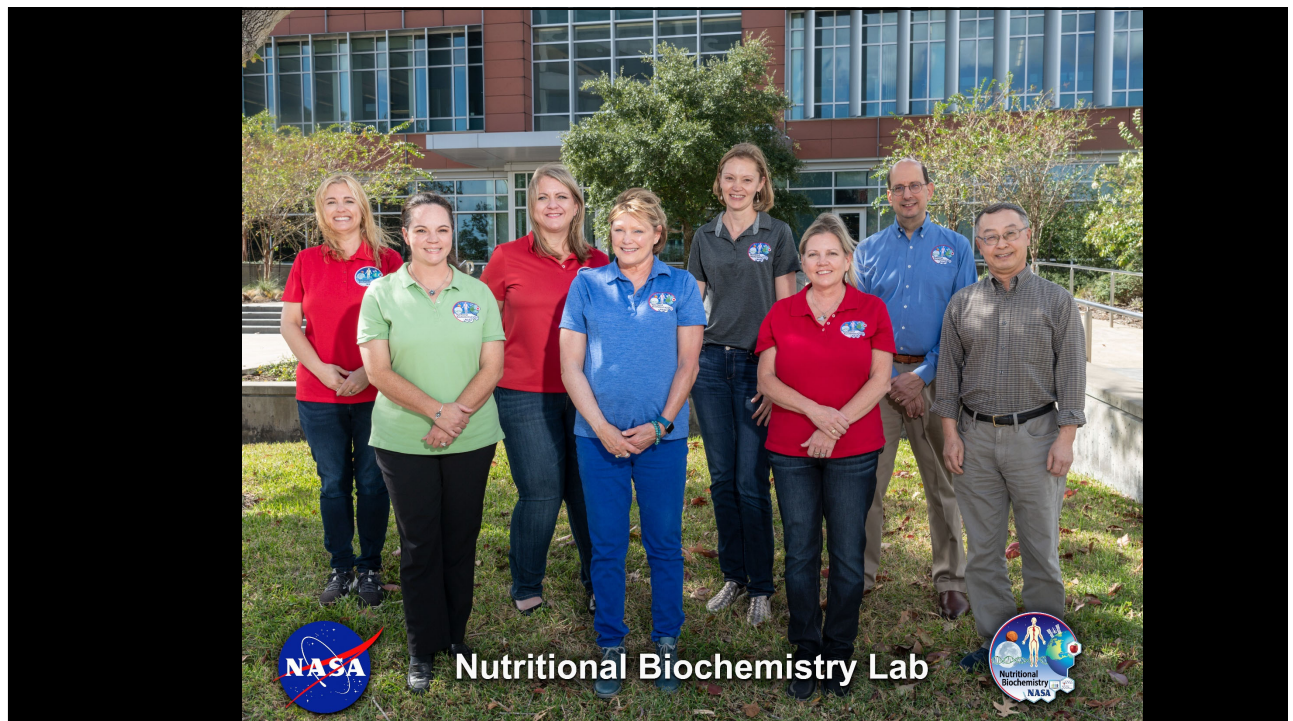
□1



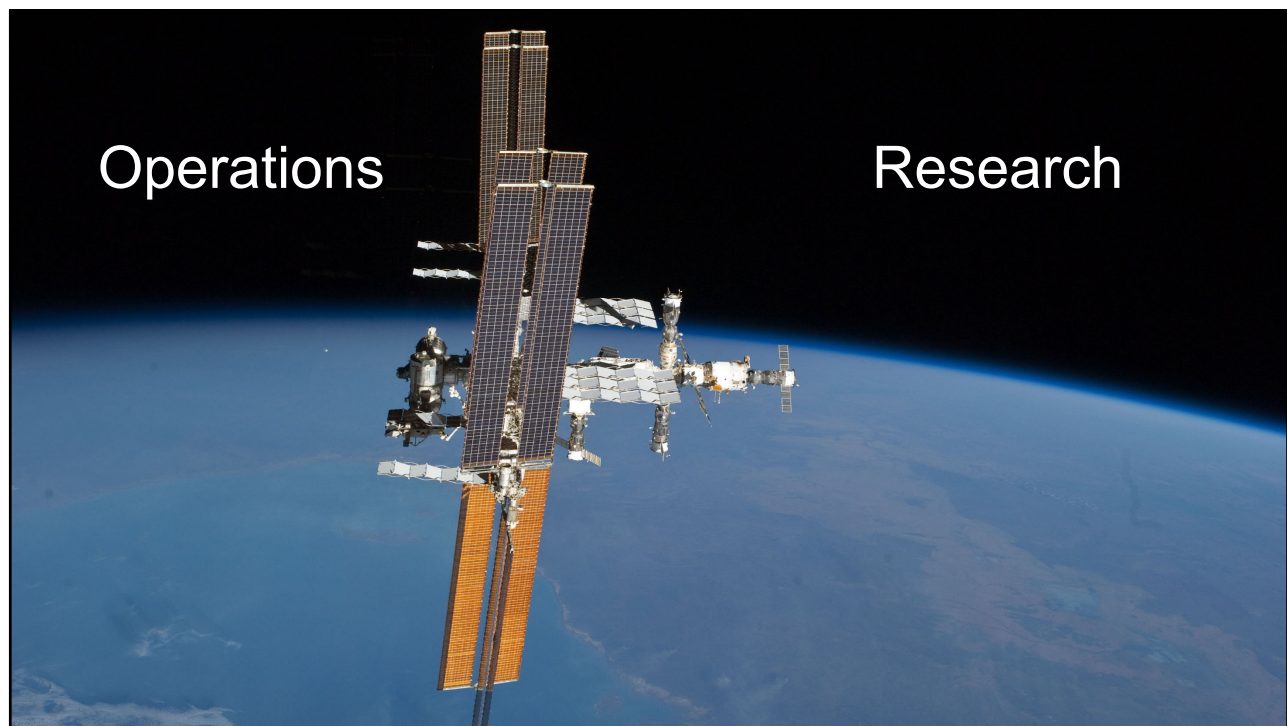
□2



3



4



5

Clinical Nutritional Assessment

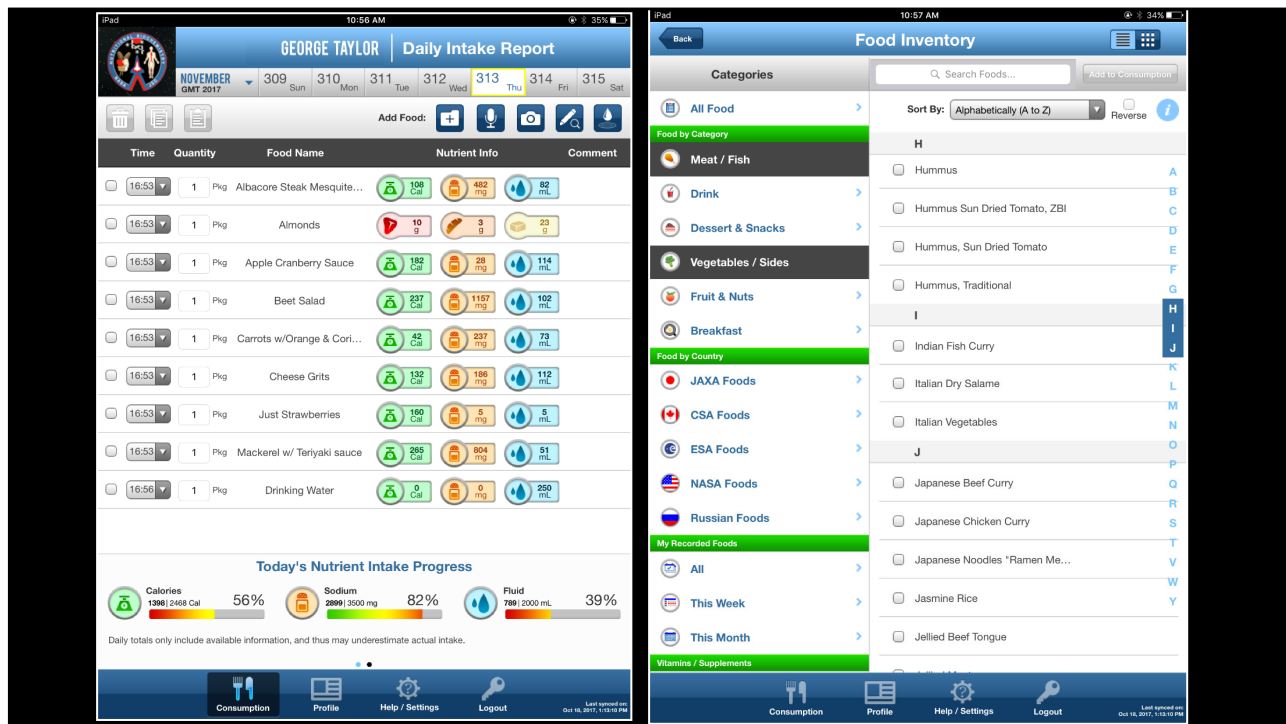
- Biochemical testing (pre, postflight)
- Crew briefings
- Inflight food intake and body mass

FMC Dietitian Consult

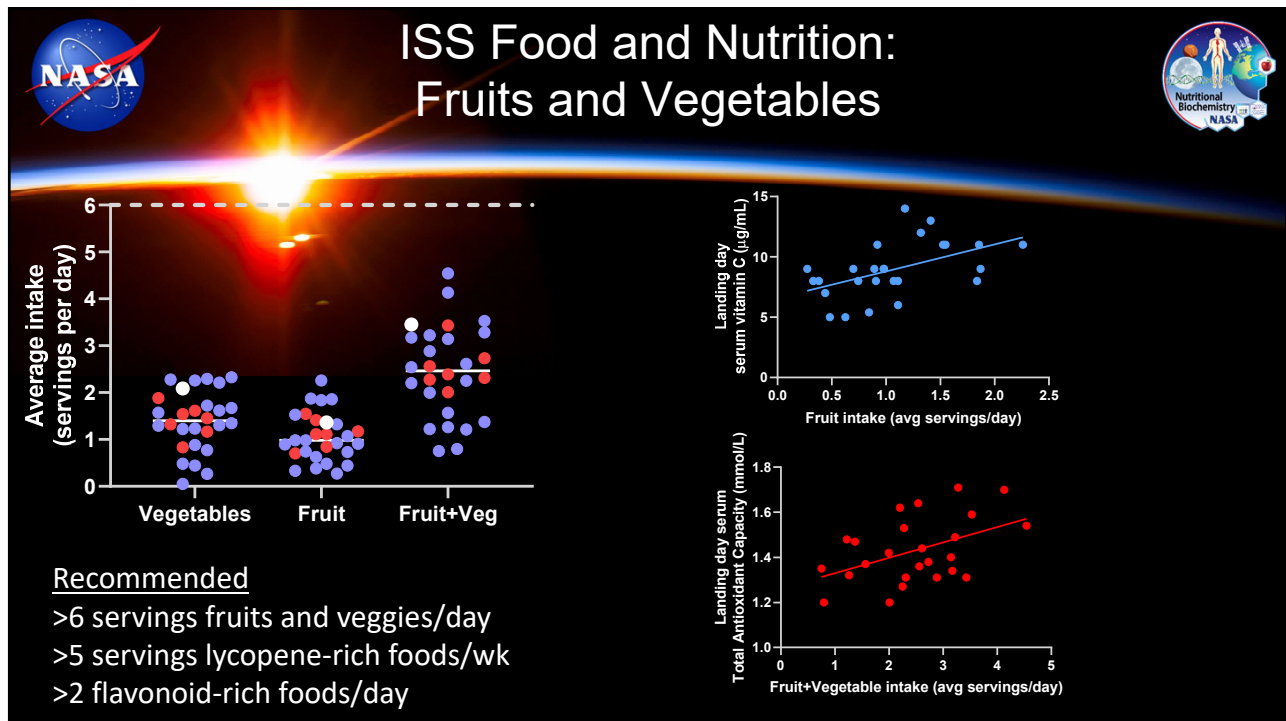
Program Requirements

Operations

6



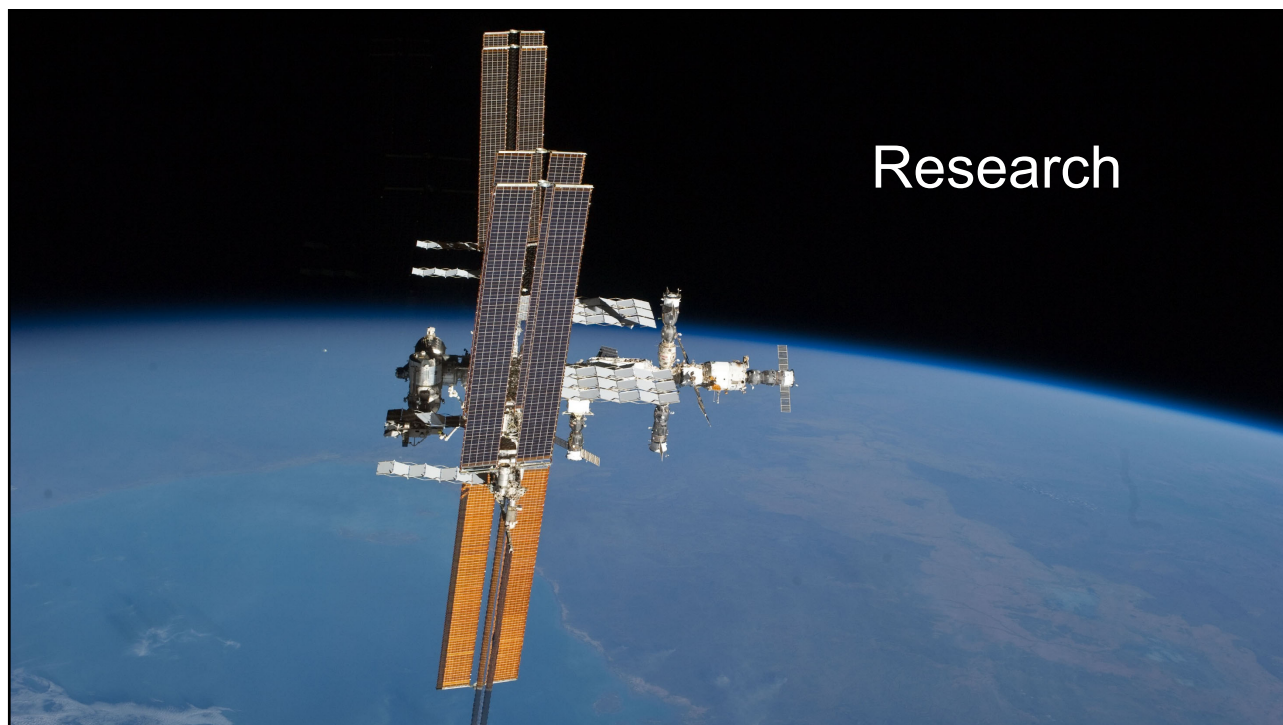
07



08



9



10

Ground-based Research

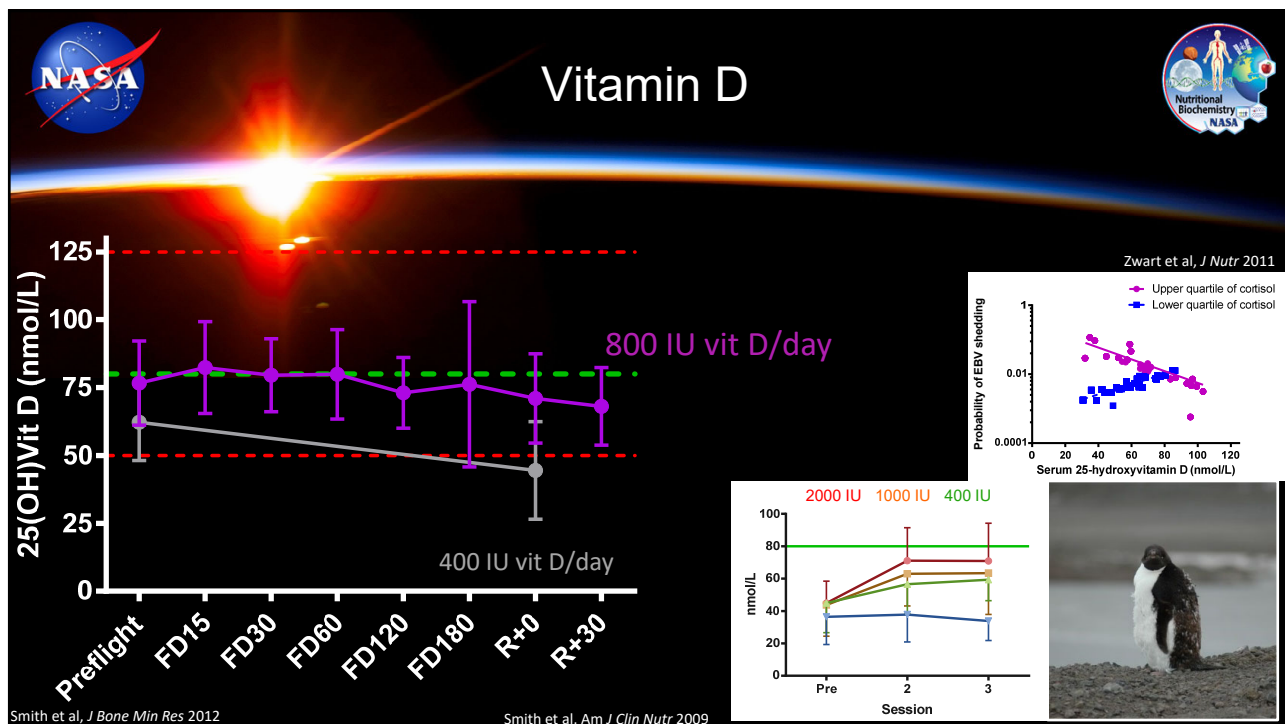


□11




Flight Research

□12



13

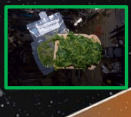
Nutrition and Bone Health




Omega-3s

Fruit/Vegetables


- Vegetable Protein
- Phytochemicals
- Flavonoids
- Lycopene
- Etc.


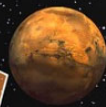




Sodium




Iron



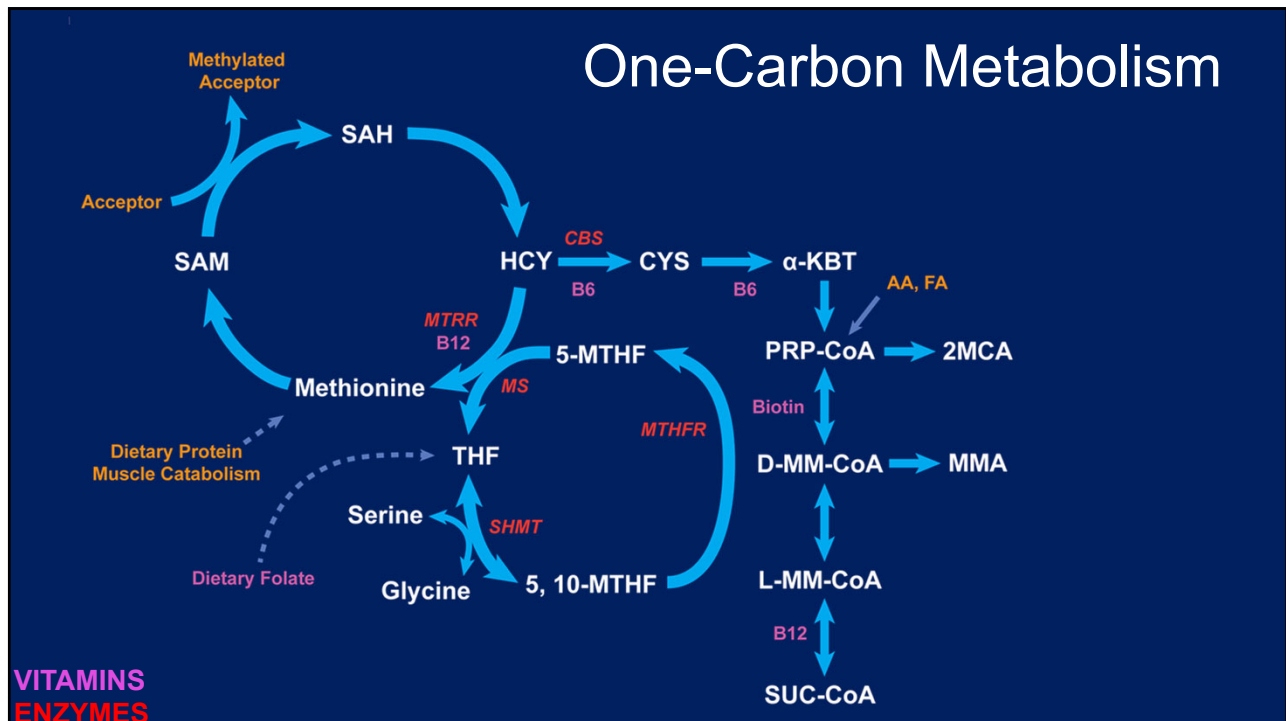




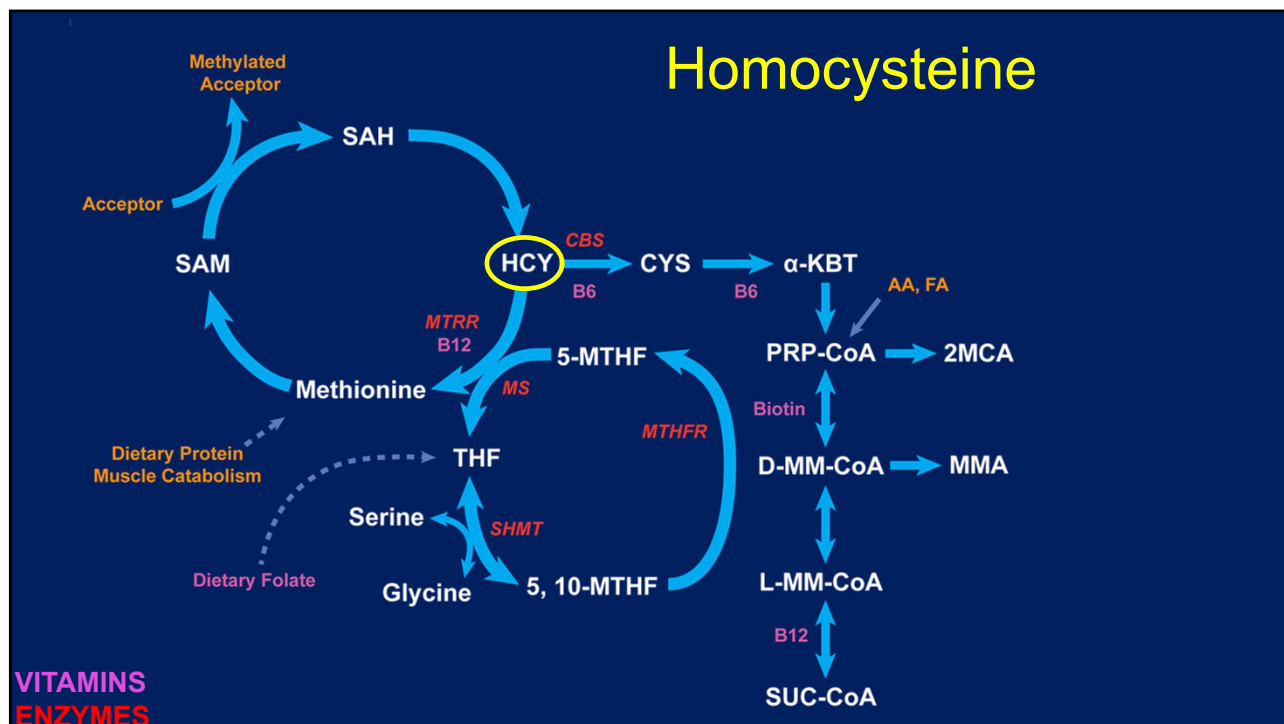
14



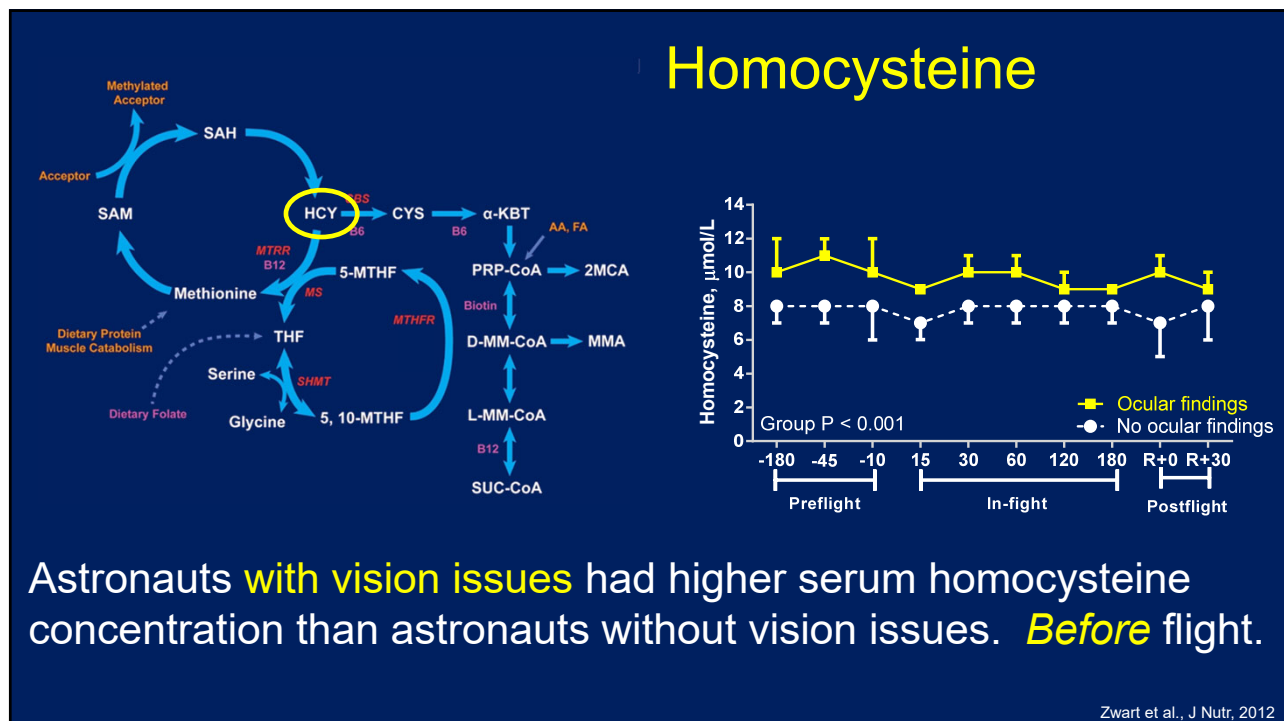
15



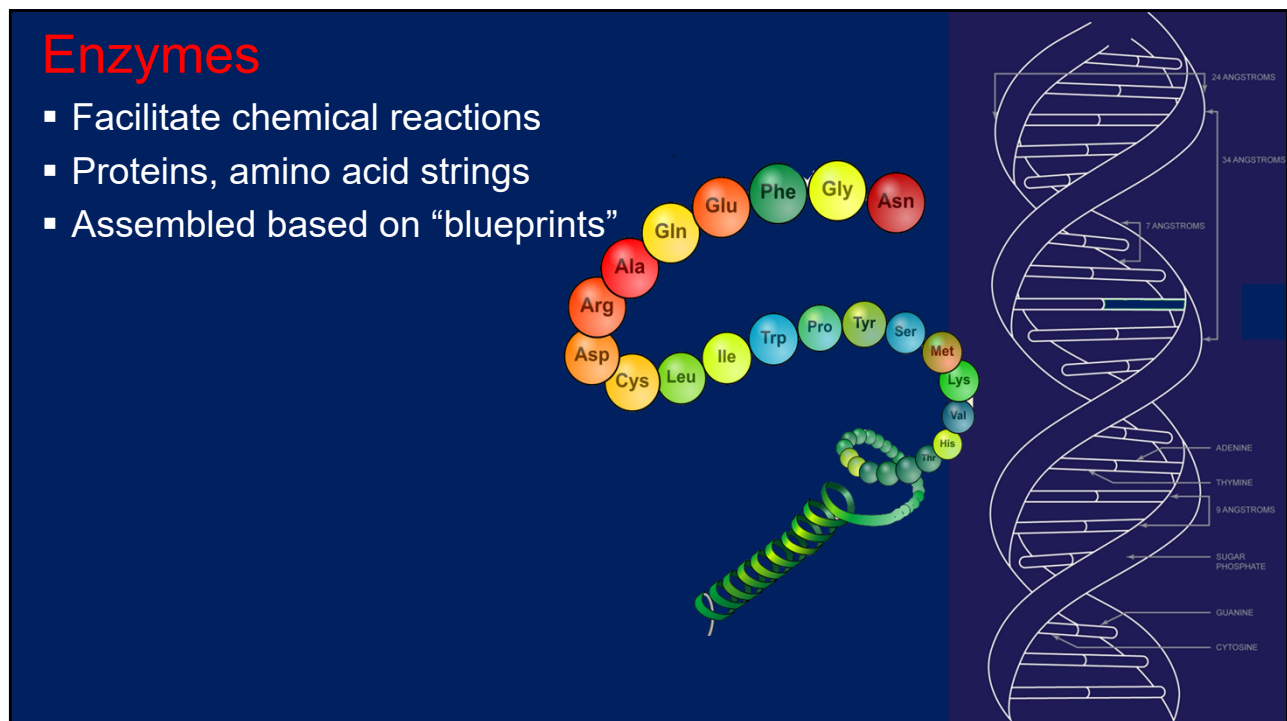
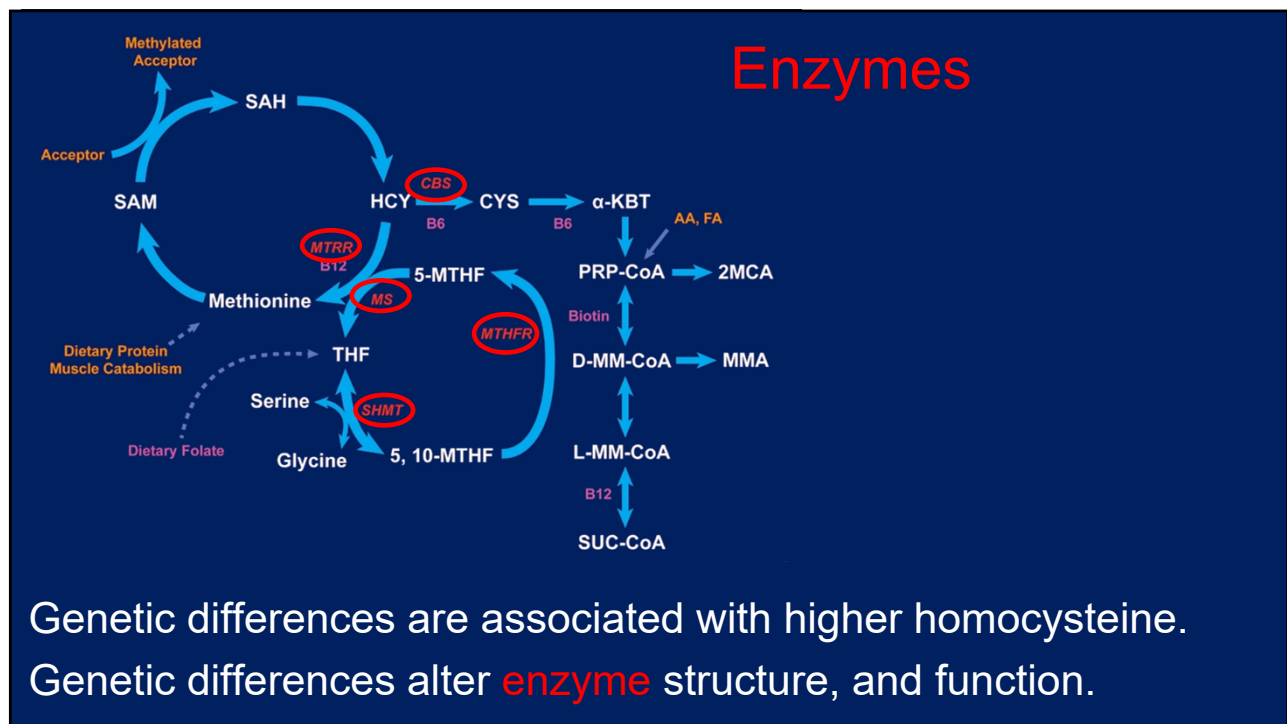
16



17



18

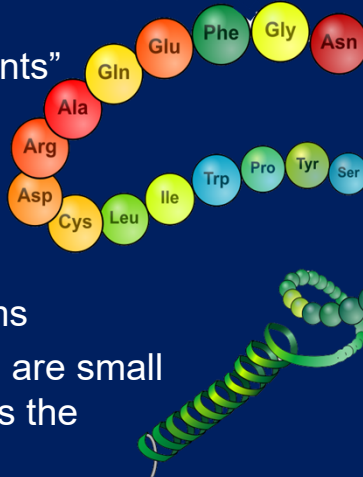


Enzymes

- Facilitate chemical reactions
- Proteins, amino acid strings
- Assembled based on “blueprints”

Polymorphisms

- poly = multiple, “morph” = forms
- For many (all?) proteins, there are small differences in blueprints across the population (e.g., blood types)
- SNP = Single Nucleotide Polymorphism

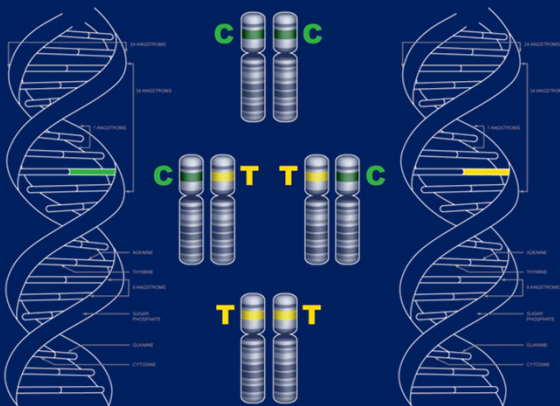


21

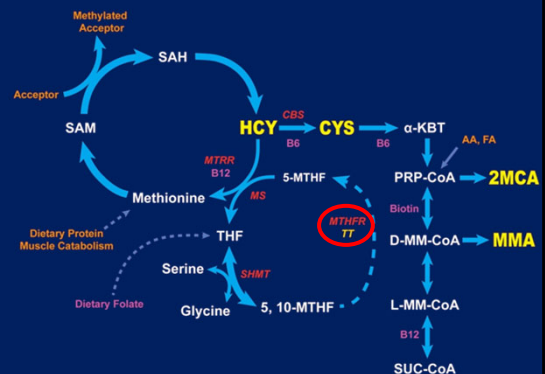
One SNP example: MTHFR C677T

Everybody has 2 sets of blueprints (mom and dad).

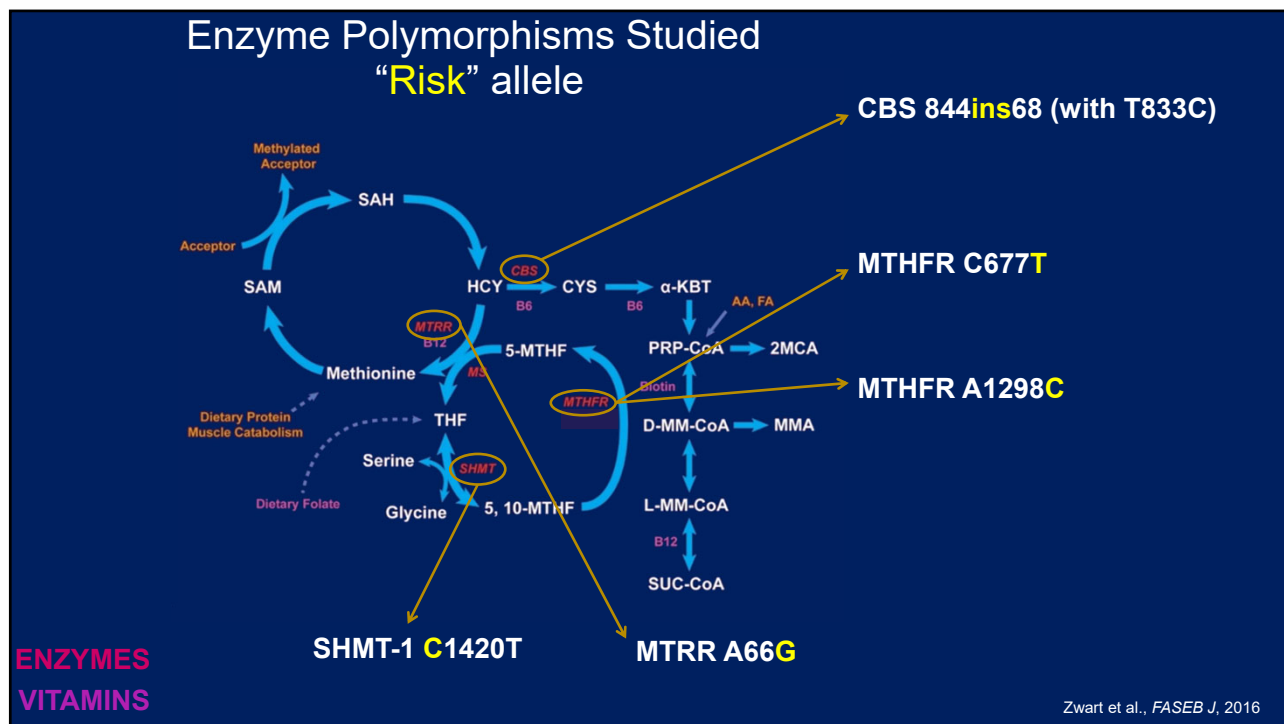
Each donates a C or a T, 4 possibilities:



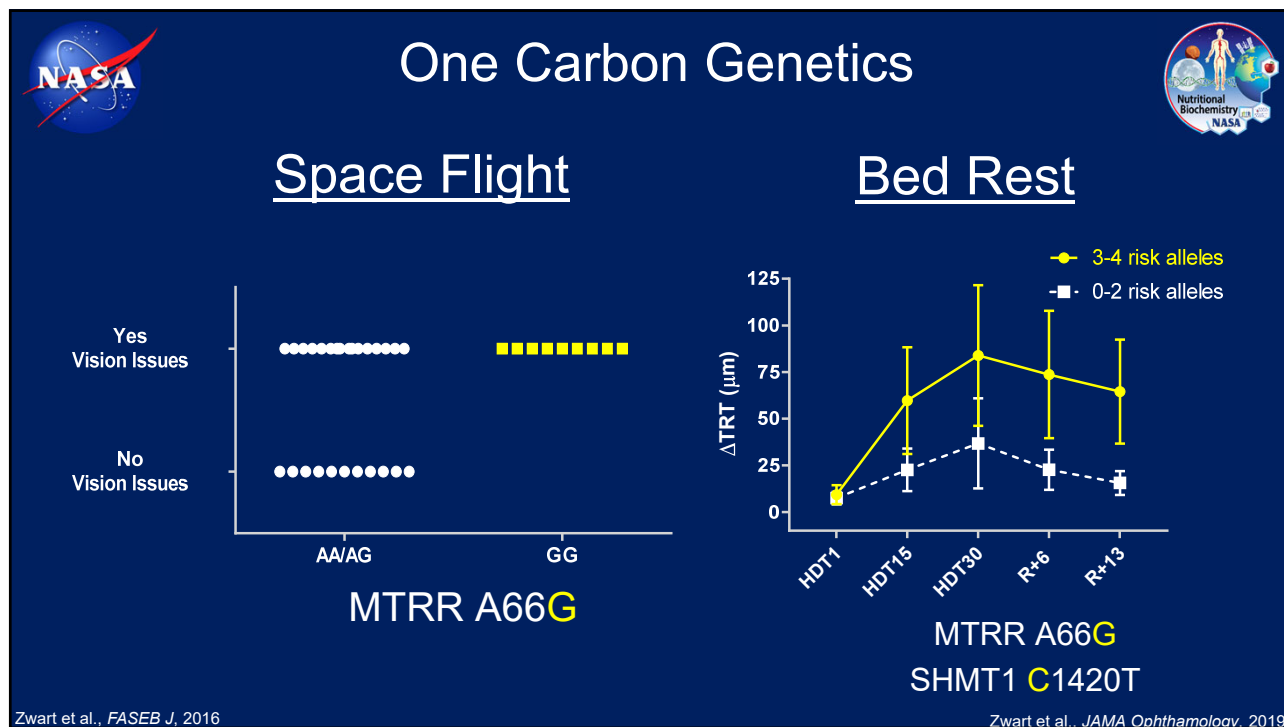
	% Population	Enzyme Activity
C/C	~35%	100%
C/T(T/C)	~50%	~66%
T/T	~15%	~50%



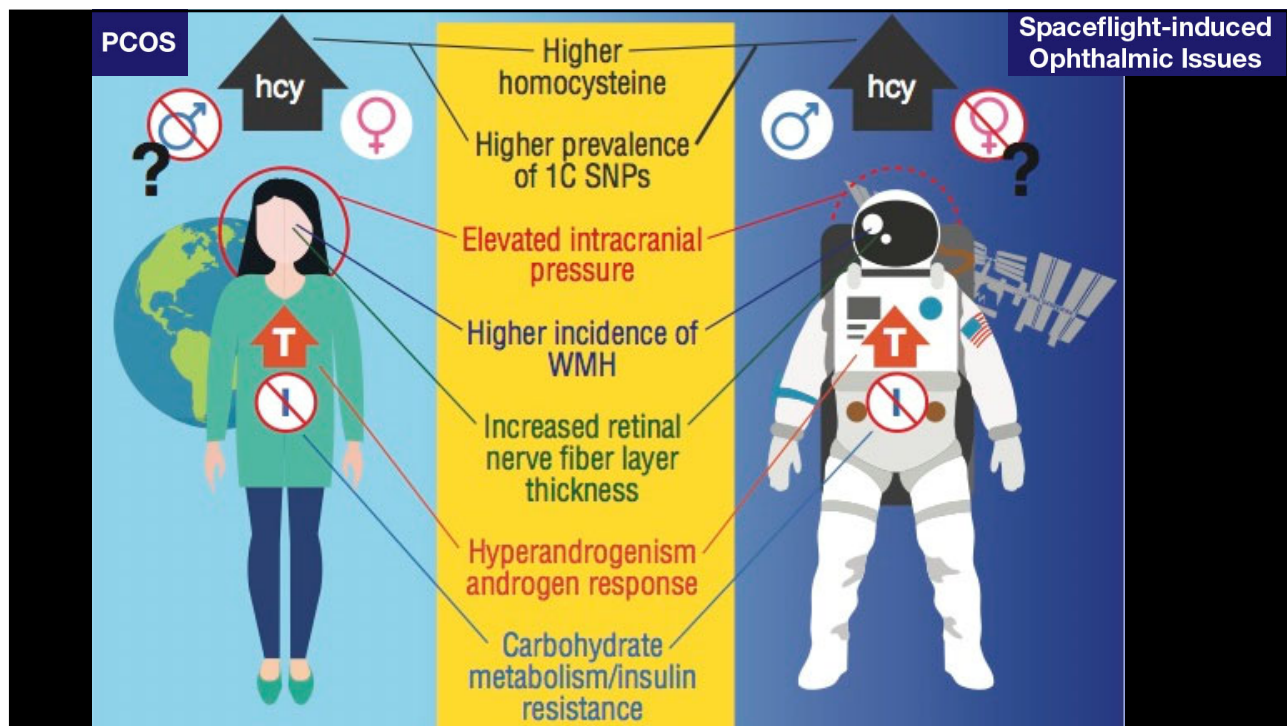
22



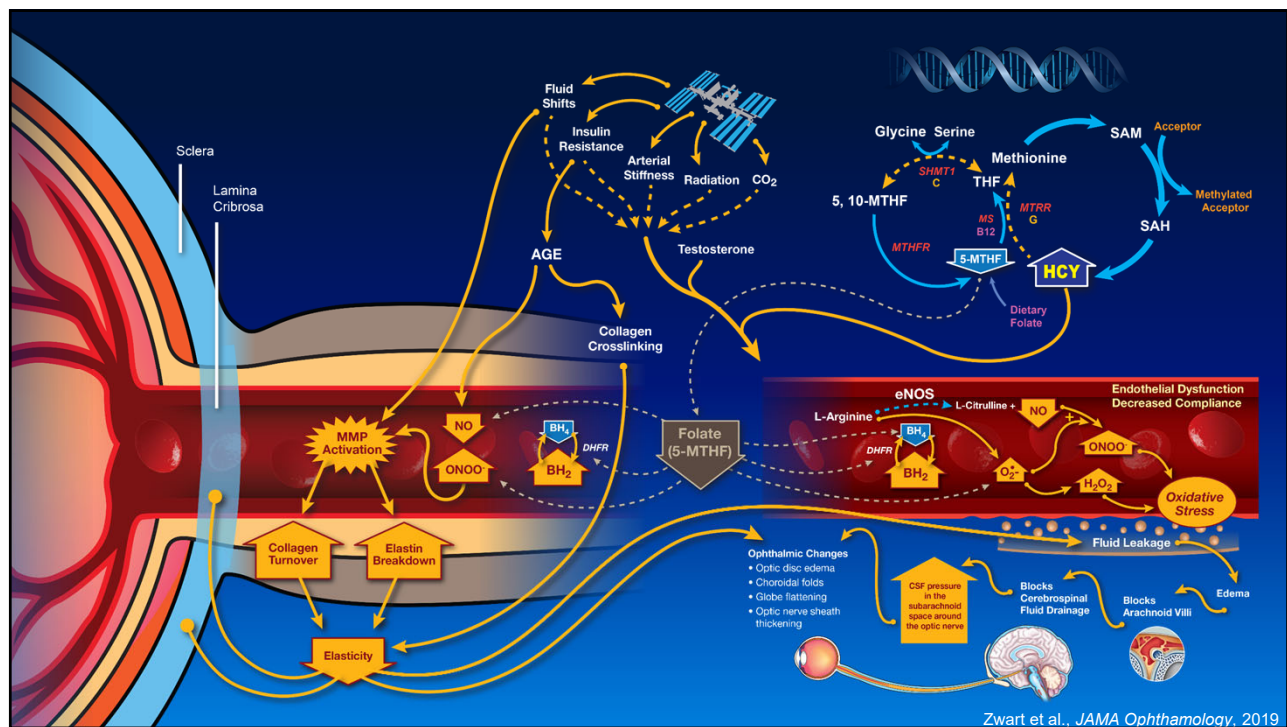
23



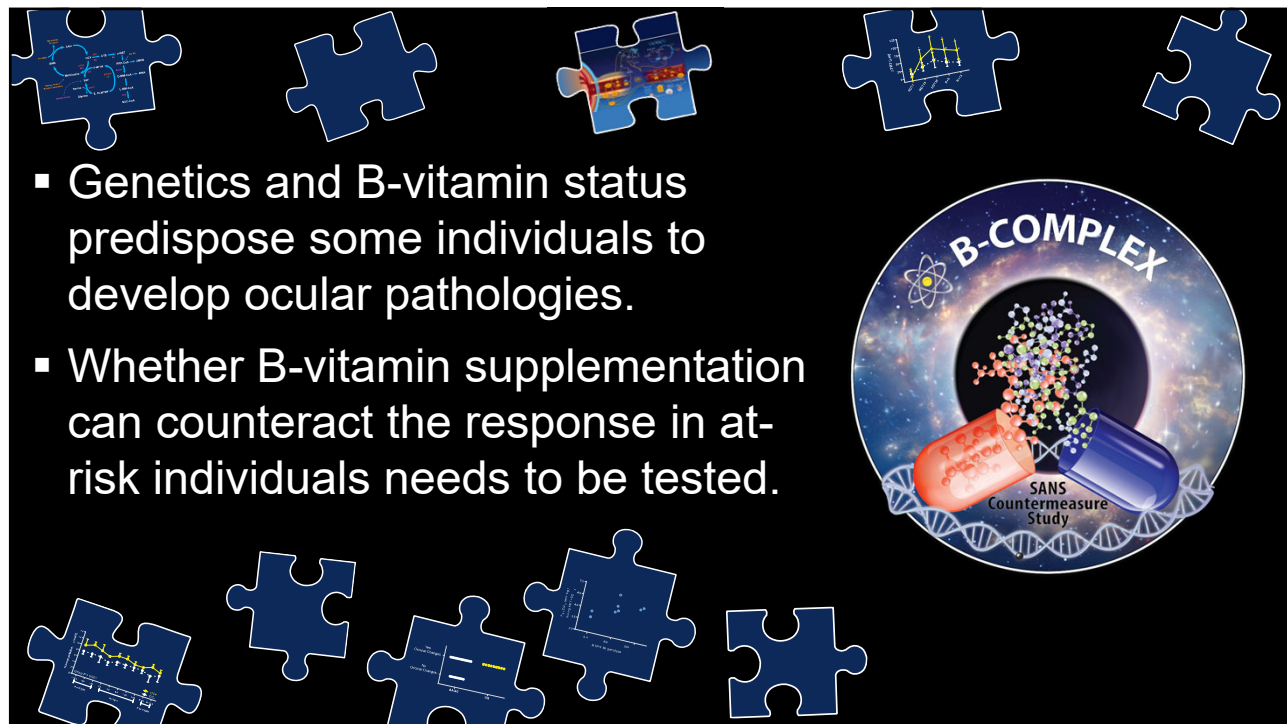
24



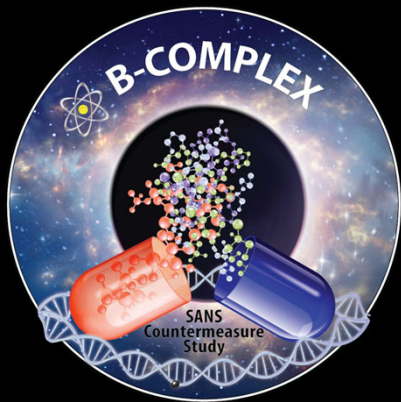
25



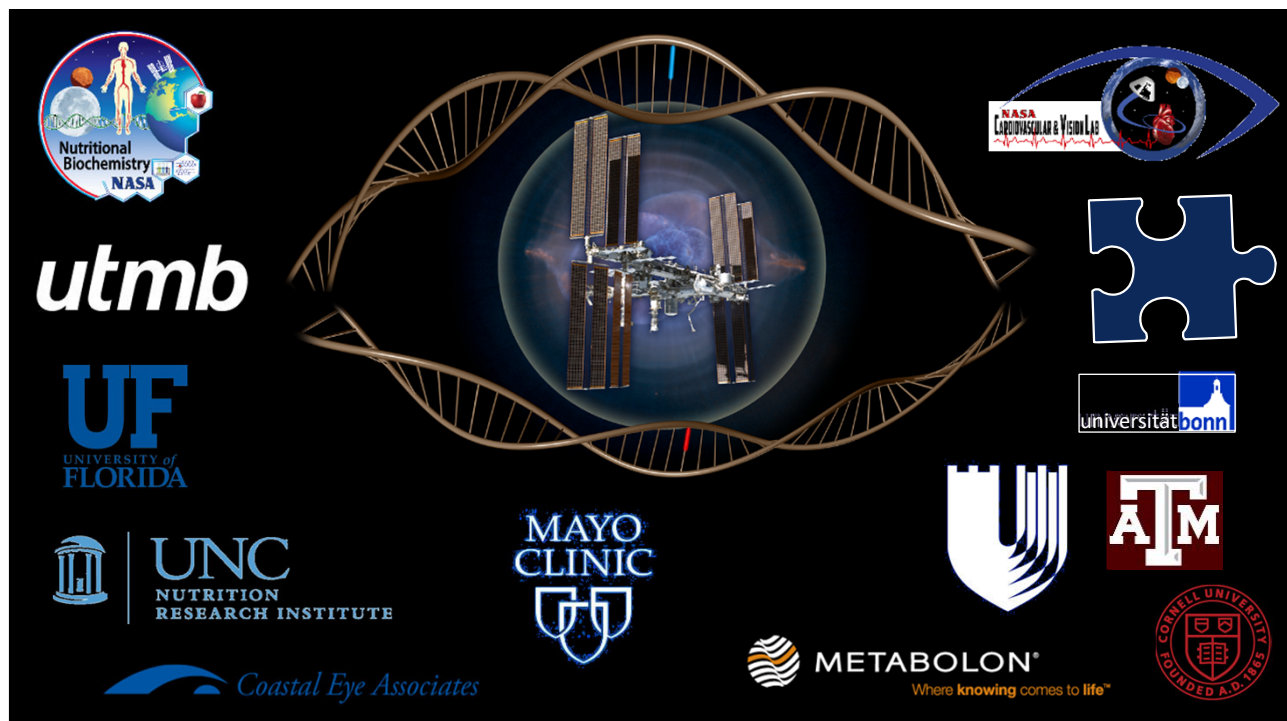
26



- Genetics and B-vitamin status predispose some individuals to develop ocular pathologies.
- Whether B-vitamin supplementation can counteract the response in at-risk individuals needs to be tested.



□27



Logos and text on the slide include:

- Nutritional Biochemistry NASA
- utmb
- UF UNIVERSITY of FLORIDA
- UNC NUTRITION RESEARCH INSTITUTE
- Coastal Eye Associates
- MAYO CLINIC
- NASA Cardiovascular & Vision Lab
- universität bonn
- ATM
- METABOLON® Where knowing comes to life™
- CORNELL UNIVERSITY FOUNDED A.D. 1865

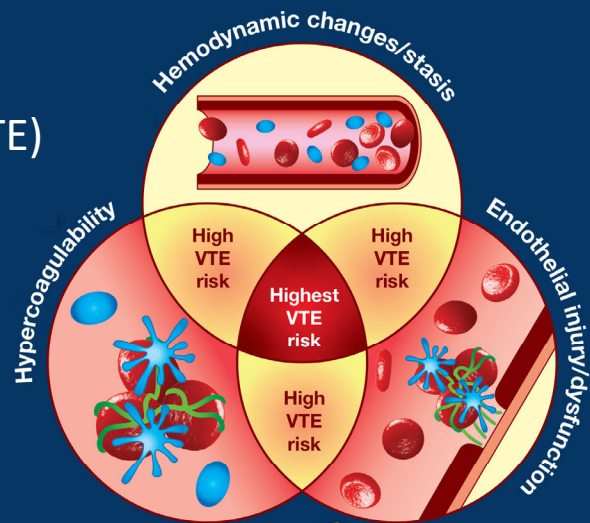
□28



□29

Venous Thromboembolism (VTE)

i.e., a blood clot in the veins



Virchow's Triad

□30

CORRESPONDENCE



Venous Thrombosis during Spaceflight

TO THE EDITOR: Approximately 2 months into an International Space Station mission, obstructive left internal jugular venous thrombosis was suspected in an astronaut during an ultrasound examination that was performed as part of a vascular research study. The astronaut reported no headache or worsening of the facial plethora

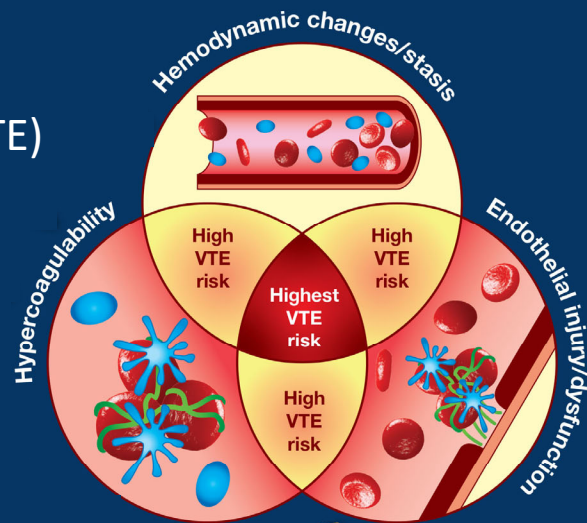
sis, and the dose was reduced to 2.5 mg twice daily 3 months after diagnosis.

Sonographic surveillance at 7-to-21-day intervals showed progressive organization and volume reduction of the thrombus (Fig. S1B and S1C). Flow through the affected internal jugular segment was first noted on treatment day 47, but

31


Venous Thromboembolism (VTE)

i.e., a blood clot in the veins




Virchow's Triad

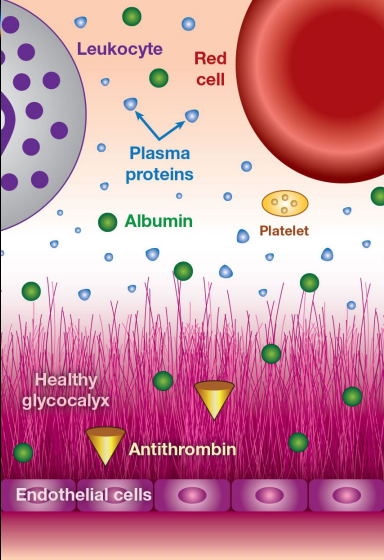
32




Albumin




- >50% of circulating protein
- Functions include:
 - Fluid balance
 - Transport of vitamins, minerals, etc.
 - Anticoagulant
 - Endothelial protection



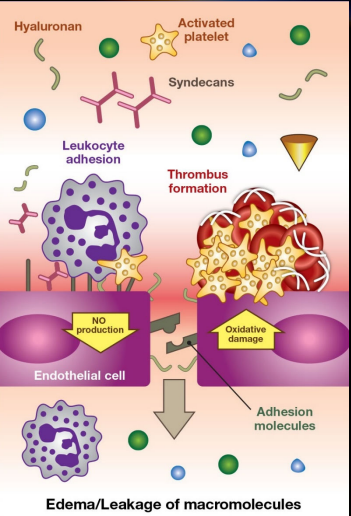
33



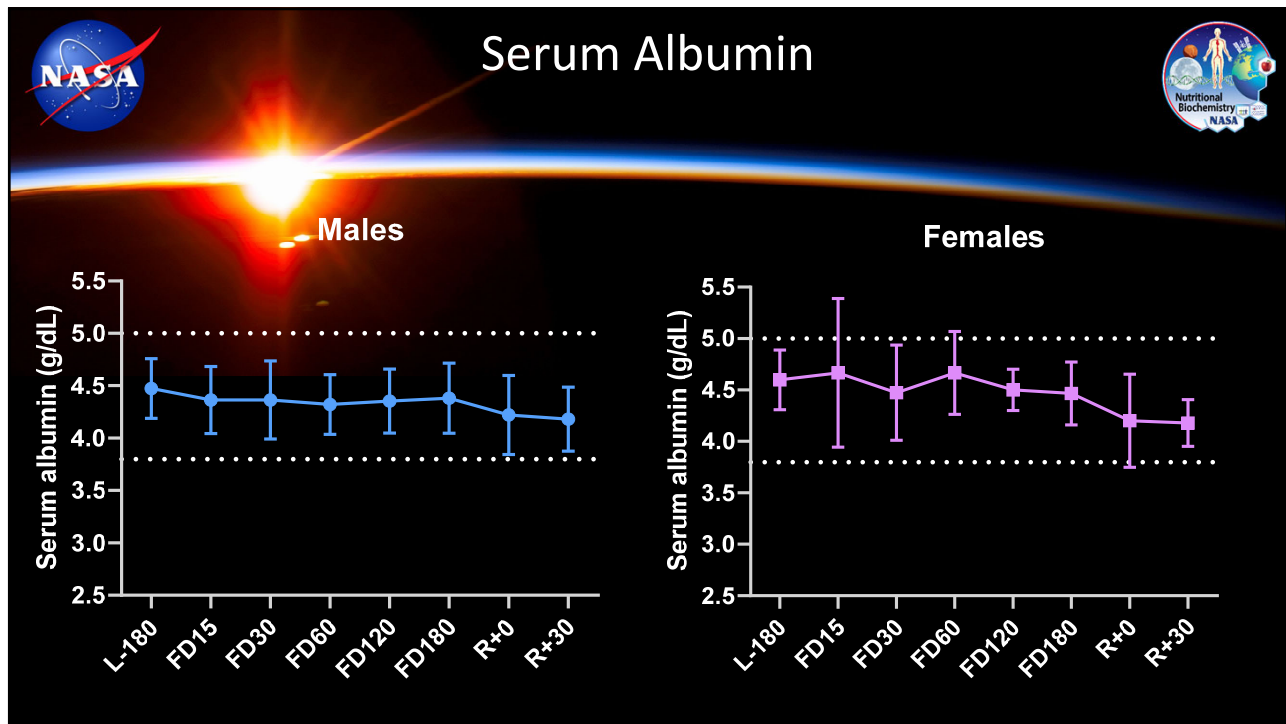
Hypoalbuminemia (low blood albumin)



- Causes of hypoalbuminemia:
 - Malnutrition
 - Kidney function changes
 - Acute and chronic inflammatory responses
- Risks of hypoalbuminemia:
 - Increased blood viscosity
 - Glycocalyx degradation
 - Blood clot formation



34

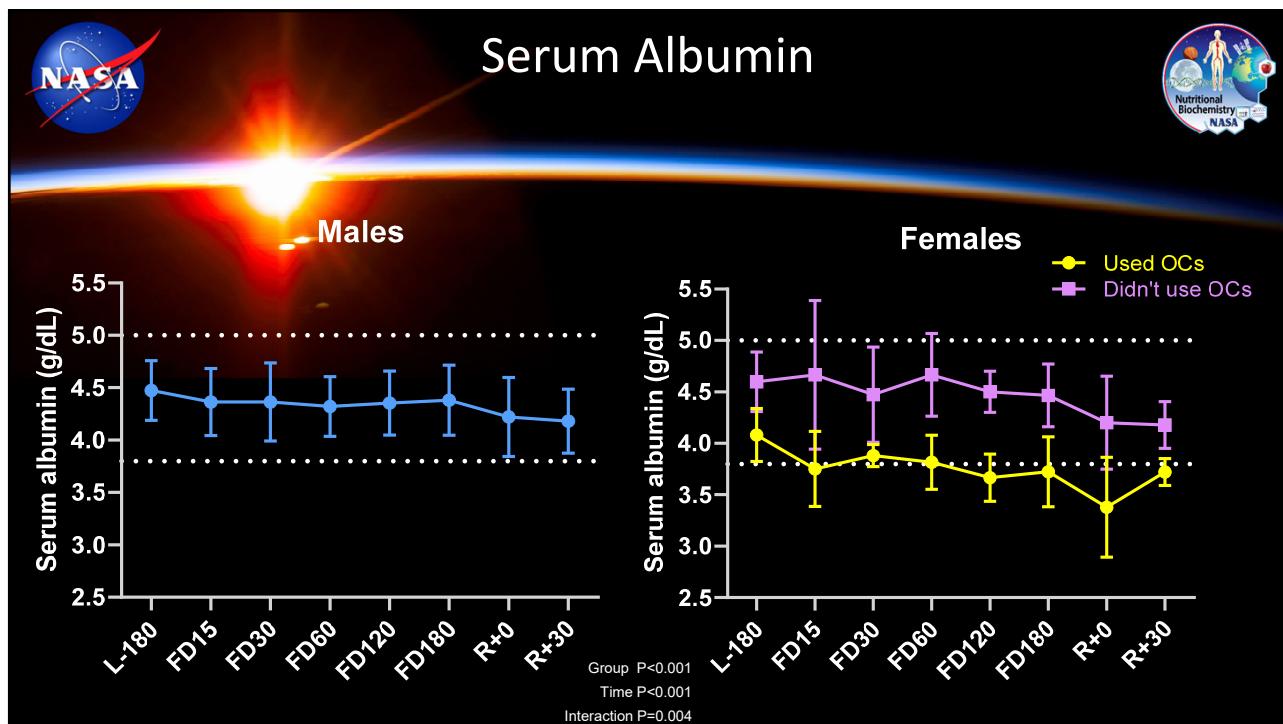


35

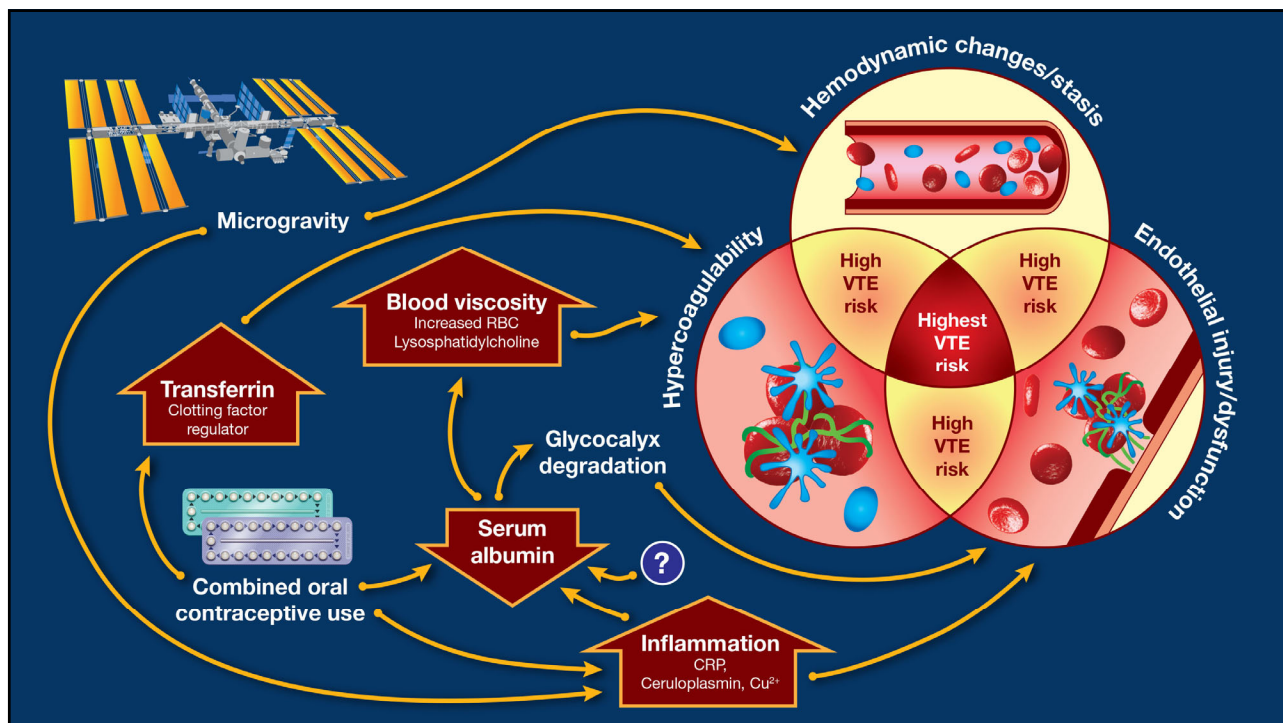
Causes of Hypoalbuminemia

- Malnutrition
- Kidney function changes
- Acute and chronic inflammatory responses
- Medications --> altered albumin synthesis
- **Oral contraceptives (OCs):**
 - Effect is dependent on type of OC and concentration of estrogen:
 - Many estrogen+progestin (aka, combined) OCs are associated with decreased serum albumin

36




37



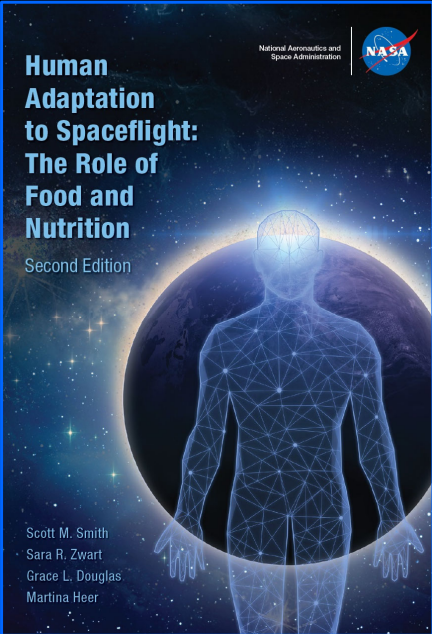
38



39

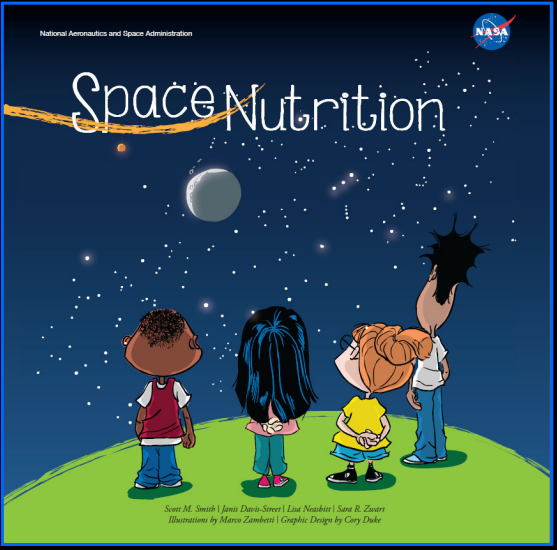


Nutritional Biochemistry
NASA



**Human Adaptation to Spaceflight:
The Role of Food and Nutrition**
Second Edition

Scott M. Smith
Sara R. Zwart
Grace L. Douglas
Martina Heer



Space Nutrition

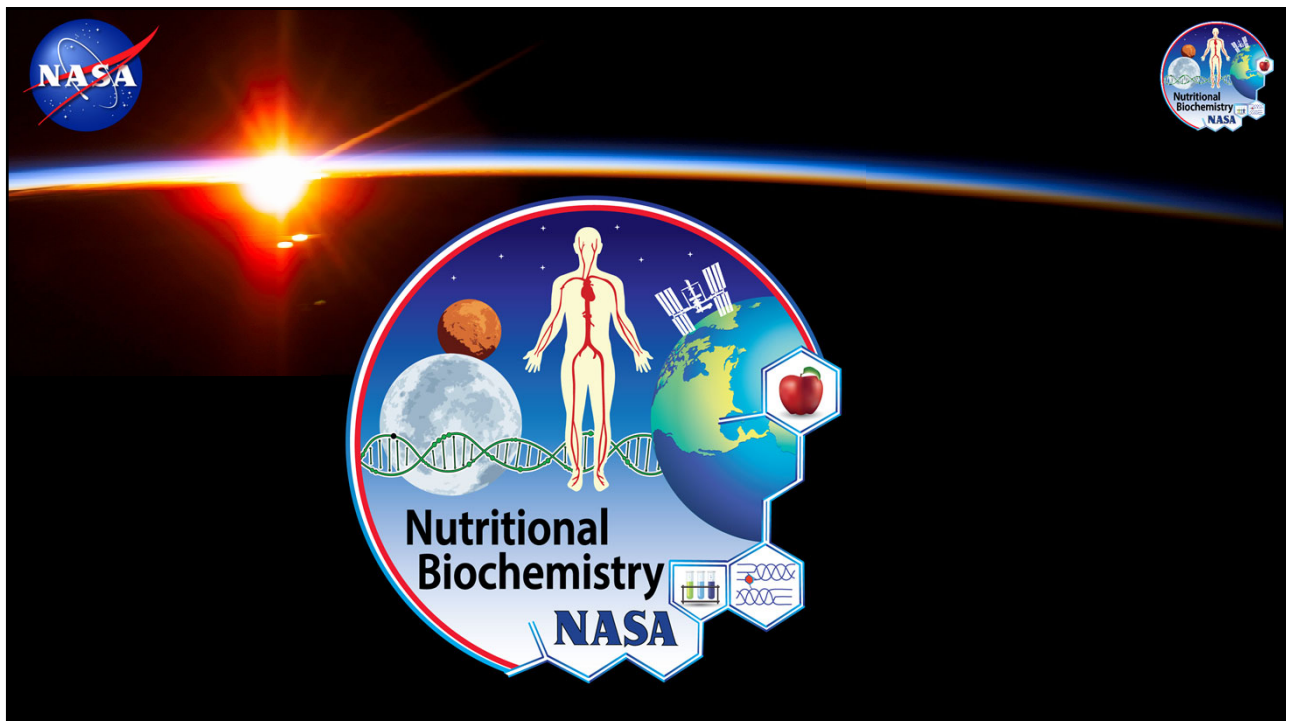
Scott M. Smith | Janis Davis-Smyer | Lisa Neuhart | Sara R. Zwart
Illustrations by Marco Zamboni | Graphic Design by Gary Duke

<http://www.nasa.gov/hhp/education>

40



41



42